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A NEW TWIST IN THE DOUBLE HELIX: ADMISSIBILITY OF DNA "FINGERPRINTING" IN CALIFORNIA

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INTRODUCTION

Undoubtedly one of the most attractive aspects of legal practice is the dynamic nature of the law. Law students and practitioners are called upon to keep abreast of developments affecting not only which remedies are available to whom for what conduct, but also *how* one best proves his or her case.[1] For decades, technological advances have found their way into our homes and offices virtually as fast as we can accommodate them. It is not surprising that they enter the courtroom and become standard tools of evidence at a similarly rapid pace.[2] As one court observed over thirty years ago in *People v. Spigno*:[3]

> Most middle aged lawyers can remember when evidence of the waves or currents given off by the cerebral tissue would have been inadmissible in any proceeding, and would have been considered fantastic. Today, no one would seriously contend that an electro-encephalogram would not be proper evidence in certain cases.

In 1989, the latest technology awaiting acceptance by the courts is identification of an individual through DNA Analysis.[4] Headlines such as "A New Forensic Test is Revolutionizing Criminal Prosecutions"[5] are appearing in newspapers, magazines, and bar associa-

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1. Researching this comment has been a case in point. I would like to thank Prof. George F. Sensabaugh, University of California, Berkeley; Dr. Russell Higuchi, Cetus Corporation; and Prof. Robert W. Peterson, University of Santa Clara School of Law for their generosity in devoting considerable time to helping me grasp many new and difficult concepts.

2. *See, e.g.*, CAL. EVID. CODE § 1500.5 (Deering 1986) regarding the impact of computers on the best evidence rule.

3. 156 Cal. App. 2d 279, 289, 319 P.2d 458, 464 (1957).

4. As suggested in the title, the current popular name for this technique is "DNA Fingerprinting." However, as discussed *infra* that name has undesirable evidentiary implications. So as not to produce still more literature describing "DNA Fingerprinting," I have chosen to refer to the technique within this comment as "DNA Analysis."

5. McCarroll & Samghabad, *Convicted by Their Genes*, TIME, Oct. 31, 1988, at 74; *see*

tion publications with increasing frequency.[6] Unfortunately, ambiguous, exaggerated and unsupported assessments of the technique's capability are found within most articles, leaving readers with an altogether false notion of what DNA Analysis can and cannot do in a forensic context.

The chief aim of this comment is to provide in-depth analysis of the admissibility of DNA evidence in California under the *Kelly/Frye* standard[7] for evaluating new scientific evidence.[8] In addition, the technique's potential as a forensic tool for identification[9] will be realistically assessed, and suggestions regarding its implementation presented. The comment also provides a description of DNA Analysis itself. This discussion is aimed at explaining to the lay reader the technology involved, hopefully without oversimplification of the underlying scientific processes.[10]

THE TECHNIQUE AT ISSUE

A Word About Deoxyribonucleic Acid (DNA)[11]

Nucleic acids comprise one of four classes of molecules of par-

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also, e.g., Michaud, *DNA Detectives,* NEW YORK TIMES MAG., Nov. 6, 1988, at 70; Moss, *DNA—The New Fingerprints,* 74 A.B.A.J. 66 (1988).

6. In addition to news media coverage of DNA Analysis, its use in a British murder investigation is the subject of a recently published non-fiction novel: J. WAMBAUGH, THE BLOODING (1989).

7. *See infra* note 36 and accompanying text.

8. At this writing, no California appellate court has yet admitted DNA Analysis evidence. Outside California, DNA Analysis received its first appellate level approval on Oct. 20, 1988 in Andrews v. Florida, 533 So. 2d 841 (Fla. Dist. Ct. App.). Trial courts in several jurisdictions (including New York, Florida, Washington, Pennsylvania, Kansas and Oklahoma) have admitted DNA evidence, as have courts in Great Britain, where forensic use of the technique was first developed; *see* White & Greenwood, *DNA Fingerprinting and the Law,* 51 MOD. L. REV. 145 (1988).

9. This comment focuses on admissibility and use in a criminal context. DNA Analysis also raises important issues in the areas of paternity and immigration law and in civil liberties. *See* White & Greenwood, *supra* note 8.

10. Suggested articles for readers interested in the actual technical literature: Jeffreys, Wilson & Thein, *Hypervariable "Minisatellite" Regions in Human DNA,* 314 NATURE 67 (1984), and *Individual Specific "Fingerprints" of Human DNA,* 316 NATURE 76 (1985); Sensabaugh, *Forensic Biology—Is Recombinant DNA Technology in its Future?,* 31 J. FORENSIC SCI. 393 (1986); Kanter, Baird, Shaler & Balazs, *Analysis of Restriction Fragment Length Polymorphisms in DNA Recovered From Dried Bloodstains,* 31 J. FORENSIC SCI. 403 (1985); Giusti, Baird, Pasquale, Balazs, Glassberg, *Application of DNA Polymorphisms to the Analysis of DNA Recovered from Sperm,* 31 J. FORENSIC SCI. 409 (1986).

11. The description of DNA included in this comment is based on presentation of this material in D. HARTL, OUR UNCERTAIN HERITAGE 218-22 (1977); readers wishing to familiarize themselves further with the scientific background can probably find information presented in a manner accessible to the layperson in most any introductory-level textbook on genetics or molecular biology. Other helpful sources—particularly for describing the

ticular biological importance, the other three classes being proteins, carbohydrates and lipids. Of the nucleic acids, DNA is the focus of much attention because it is the storage site for all genetic information in any living thing. DNA is found within cells as an extraordinarily long, threadlike molecule, consisting actually of two threads intertwined with each other, like the red and white stripes of a barber pole. DNA molecules exist "balled up" inside cells, but if a single DNA molecule found within the average human chromosome were stretched out to its full length, it would measure approximately one and a half inches. To conceptualize these dimensions on a larger scale: if a DNA molecule were as thick as a strand of spaghetti, it would be over *ten miles long*. The structure of DNA is known as a *double helix*.[12] "Double" refers to the two intertwined threads; "helix" refers to the coiled shape of the molecule, similar to a spiral staircase. Each of the two threads of a molecule of DNA is made up of "beads" called *nucleotides*, which can be grouped into four *bases*: adenine (A), guanine (G), thymine (T), and cytosine (C). Each "bead" on one of the strands in a molecule is paired with a complementary "bead" on the other strand according to the following rule: where one strand has an A, its partner strand has a T; where one strand has a G, the other has a C. Each molecule of human DNA contains approximately *three billion* such base pairs. Therein lies the basis for identification through analysis of an individual's DNA: the sequence of the three billion A, T, G, and C base pairs within a strand of DNA is theoretically unique to the individual.[13]

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technique of DNA Analysis to judges or juries—may be J.D. WATSON, THE DOUBLE HELIX (1968); J. GOCKNICK, A CARTOON GUIDE TO GENETICS.

12. The double-helical structure was first discovered in 1953 by James Watson and Francis Crick, working at Cambridge University; *see* Watson & Crick, *Molecular Structure of Nucleic Acids*, 171 NATURE 737 (1953), regarded as one of the most significant reports in the history of biology.

13. A new focus of DNA research is the Human Genome Project. The fifteen year project is aimed at mapping the DNA within human chromosomes in hopes of one day being able to identify all three billion base pairs in terms of the location of particular bits of genetic information in the DNA chain. *See, e.g*, Nash & Thompson, *Solving the Mysteries of Heredity*, TIME, March 20, 1989 at 62. At this time, the sites of hereditary traits, diseases etc., within the DNA molecule remain virtually unknown. However, the eventual mapping of DNA could have significant impact on DNA Analysis: such information would allow researchers to check that restriction fragment lengths obtained as part of the test are not merely indicators of gender, eye color, hair texture or other traits shared by millions of people; but rather are uniquely identifying genetic features. DNA mapping will be of great potential importance for forensic identification by someday enabling scientists to examine specific sites within DNA found at a crime scene and formulate a detailed description of the individual from which it came. Identification based on DNA mapping is at least twenty years away, however. In the meantime, the possibility that restriction enzymes in particular DNA Analy-

Techniques Involved in DNA Analysis[14]

Bearing in mind the basis for uniqueness, i.e., that each person possesses a DNA nucleotide sequence which is uniquely his or her own,[15] it is now important to separate theory from practice and briefly describe the forensic test responsible for so many expectations in the legal community. Worth noting at the outset is a fact rarely taken into account in any assessment of the technique's potential significance: DNA Analysis does not compare the *entire* sequence of a defendant's DNA with the *entire* sequence of the DNA obtained from biological samples found at a crime scene. Were that the case, the notion of absolutely identifying the perpetrator of a crime would be justified, based on an exact match of all three-billion-or-so base pairs. What DNA Analysis does do is identify an individual based on an extremely low *probability* that the DNA obtained from a defendant and the DNA obtained from crime scene samples came from two different individuals. The likelihood that the analyzed pieces of DNA from the crime scene would "match"[16] only the defendant's DNA can, according to proponents, approach theoretical certainty of identification.[17] Nonetheless, the point bears repeating that this remains an identification based on *probability*, namely, the probability that nucleotide sequences from different individuals would not produce the same result when "cut up" and analyzed in the manner described below.

There exists, then, a huge conceptual difference between theory and practice: in theory, no two people are alike; in practice, no two people should *test* alike. While this distinction may not ultimately alter the weight of DNA evidence in the courtroom, the risk of ignoring the difference is that the trier of fact may assign weight to the evidence based on misconceptions of what the evidence actually represents.

The technique which is currently the most frequently employed in performing DNA Analysis is called Restriction Fragment Length Polymorphism (RFLP).[18] This form of DNA Analysis can

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ses could produce fragments representing nothing more than the most common genetic characteristics is one which deserves further scrutiny.

14. For other discussions of this area *see* Comment, *DNA Fingerprinting: Possibilities and Pitfalls of a New Technique*, 28 JURIMETRICS J. 455 (1988); MOENSSENS et al., SCIENTIFIC EVIDENCE IN CRIMINAL CASES 356-58 3d ed. 1986.

15. The case of identical twins is the exception to this rule.

16. A "match" in this context means basically that the pattern of DNA fragments is the same in both samples tested; six to eight such lengths are typically compared in the test.

17. Circumstantial evidence will likely exist as well, adding to the degree of certainty.

18. There are three laboratories in the United States presently performing DNA Analy-

be broken down into five basic steps.

1. DNA is extracted from the cells of the sample to be tested (blood, semen, hair, skin etc.).[19] The DNA is then evaluated on the basis of quality and quantity.[20]

2. The DNA obtained in Step 1[21] is then treated with molecules called *restriction enzymes* which are "programmed" to "cut" the DNA at certain pre-determined points ("restriction sites") in the DNA nucleotide sequence. Different restriction enzymes recognize different sequences, generally ranging in length from four to eight bases (although enzymes which recognize longer sequences are also available.) For example, Restriction Enzyme #1 might cut the DNA everytime it recognizes the base sequence GGCC, Restriction Enzyme #2 might cut after every GAATTC sequence, etc. Because the order of bases in an individual's DNA is a constant, exposing that individual's DNA to a certain restriction enzyme will produce the same pieces every time.

3. The fragments of DNA obtained in Step 2 are then "sorted" according to their length. This is achieved by placing the fragments into a gel slab (resembling the consistency of Jell-O). Electrical current is then applied to the gel, causing the DNA

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sis for forensic application. They are Cellmark Diagnostics of Germantown, Maryland; Lifecodes Corp. of Valhalla, New York; and Cetus Corp. of Emeryville, California. All three perform substantially the same analysis, but with some variations. The most common form of DNA Analysis is called Restriction Fragment Length Polymorphism (RFLP). Cetus Corp. is the only one of the three to utilize a technique called the "polymerase chain reaction (PCR)" which uses an *in vitro* reaction to synthesize exact copies of the DNA being analyzed. Cetus claims that the PCR technique permits analysis of quantities of DNA which would be prohibitively small by other methods' standards. For example, where RFLP analysis without PCR would require five or six hairs in order to obtain enough DNA, experiments using the PCR technique have produced analyzable results from the DNA obtained from a single hair. On PCR (a/k/a DNA amplification) *see* Higuchi, von Beroldingen, Sensabaugh & Erlich, *DNA Typing From Single Hairs*, 332 NATURE 543 (1988); Erlich, Gelfand and Saiki, *Specific DNA Amplification*, 331 NATURE 461 (1988); Saiki, Gelfand, Stoffel, Scharf, Higuchi, Horn, Mullis & Erlich, *Primer-Directed Enzymatic Amplification of DNA with a Thermostable DNA Polymerase*, 239 SCIENCE 487 (1988).

19. Extraction of DNA is achieved by subjecting the sample to a solution containing a detergent and proteinase which breaks down cells, freeing nucleic acids, proteins and lipids. The sample is then treated with a phenol and water solution (carbolic acid) in which the proteins, lipids etc. end up in the denser phenol layer, while the nucleic acids end up in the water layer. Ethynol is then added, enabling collection of the nucleic acids from the solution.

20. The amount of DNA contained in the samples to be tested is not of great importance because identification is based on the location rather than density of the dark bands produced on an autoradiograph. (*See* discussion *infra*.) Exact molecular measurement is thus not a critical aspect of the test. The quality of the DNA obtained is important, however, as a very damaged sample precludes DNA analysis.

21. Standard laboratory procedure at each step in the process is to use *half* of the material available at that point, saving the other half should any need arise for retesting.

(which is by nature negatively charged) to migrate toward the positively charged end of the gel. The shorter the fragment, the less resistance it encounters in passing through the gel and thus the farther it will travel in a given time.

4. A procedure known as a "Southern Blot" (named for its inventor) is then performed which basically transfers the DNA fragments—now arranged within the gel according to their length—to a sheet of specially prepared paper, preserving their positions exactly as they were in the gel.

The DNA fragments are also "denatured" at this time, that is, the two strands which form the molecule are separated from one another for the purpose of creating and applying *probes*. Because there are at this stage fragments of up to a million different lengths, probes are used to identify and examine fragments of only a few of those lengths. A probe consists of a single strand of DNA of a known length and sequence. Probes are created in one of two ways, either by isolating part of a known DNA sample or, more commonly, by synthetic production of an oligonucleotide sequence. Once the desired probe sequence is obtained, it is then labeled with a radioactive marker. Recalling that bases match only according to the pattern A-T and G-C, the single-strand probe, when released into the Southern blot, will seek out and attach itself *only* to the single-strand fragments possessing its exactly complementary configuration.[22] What results is a blot with several (depending on how many probes were created and applied) radioactively labeled double-strand fragment lengths.

5. A piece of X-ray film is then placed in contact with the blot to create what is called an *autoradiograph*. At each site where a radioactive probe paired with complementary fragments, a dark band will appear, its density varying with the amount of labeled DNA present at that position on the blot. (See photograph, following.) It is this resulting pattern of bands that has been referred to as an individual's "DNA Fingerprint".[23] The idea is in essence that a restriction enzyme applied to two samples of the *same* DNA would yield fragments of the same lengths, while a restriction enzyme applied to samples of DNA from different individuals would yield

22. For example, a probe fragment consisting of the sequence AATGCC would only pair with a blot fragment of TTACGG. Bear in mind, however, that these base sequences are merely used to illustrate the principle involved; the actual size of such probe fragments is several hundred to several thousand bases long.

23. The name "DNA Fingerprint" is proprietary, despite its increasingly generic usage in the legal community. Cellmark Diagnostics is the patent holder for the multilocus test originally developed in England by Dr. Alec Jeffreys.

The above photograph shows the band patterns which result from DNA Analysis. Two probes were applied in this test. The two pieces of evidence examined were a semen stain and a vaginal swab. The DNA pattern from Suspect #1 matches that from the evidence; Suspect #1 is included *by this test. The DNA pattern from Suspect #2 does not match; Suspect #2 is* excluded *as a possible donor of the semen. The lanes designated as "Marker" are included for measurement purposes, each band representing a known fragment length. The "PST Control" is a quality assurance device consisting of DNA from a known sample. Analysts know where the "PST" bands should appear relative to the "Markers"; any deviation would alert them to inaccuracies in the gel. Photograph courtesy Lifecodes Corporation.*

fragments of different lengths. Since the number of lengths to be analyzed corresponds to the number of different probes applied, the degree of specificity of identification increases with the number of probes used.

As this brief description of the RFLP technique shows, DNA Analysis is not a comparison of the exact sequence of all the bases making up the samples analyzed, but is rather a comparison of how those samples react to restriction enzymes and probes. Thus, it is a test which when used for inculpatory purposes indicates that a defendant's DNA contains the same pattern of restriction fragments of particular lengths as does the DNA recovered from biological samples found at a crime scene. Although the likelihood is at best very, very slim that such a match could be the result of biological coincidence, the test remains one of inclusion/exclusion rather than one of absolute identification, which is quite different from the impression one gets from popular press coverage of the technique.

Calculations of Probability

DNA Analysis is similar to other forms of genetic testing: as ever greater portions of the population are excluded from the class of possible sources of the sample in question, the inference of identification grows stronger. The extraordinarily high probability figures for inclusion or exclusion obtained through DNA Analysis are largely responsible for the technique's notoriety. Probability figures vary according to which probes are used and how many are applied. The basis for calculation is the number of times a particular pattern of bands has been observed in applications of a given probe to DNA samples from different donors. A greatly simplified calculation will illustrate this process:

a. Assume that probes 1, 2 and 3 have each been used in the DNA Analysis of 2,000 individuals. Phrased another way, the database for each probe equals 2,000.

b. Every probe application yields a pattern of bands. A marker is used to plot the location of each band on the blot and to determine the length of fragments found at that locus (based on the different rates of travel of various sized fragments through the electrically charged gel.) The pattern resulting from each probe application is entered into the database for that probe.

c. Probes 1, 2 and 3 are applied to the DNA samples to be used as evidence in a particular case. If, for example, the defendant's DNA band pattern matches that of the crime scene sample, the calculation would proceed as follows:

$PROBE_1$	resulting pattern observed 4 times within the database (4/2000)	frequency of occurrence = 1 : 500
$PROBE_2$	resulting pattern observed 10 times within the database (10/2000)	frequency of occurrence = 1 : 200
$PROBE_3$	resulting pattern observed 2 times within the database (2/2000)	frequency of occurrence = 1 : 1000

d. The three frequency figures are then multiplied:

$$1/500 \times 1/200 \times 1/1000 = 1/100{,}000{,}000$$

The resulting figure represents the probability that the two matching samples (here, DNA from the defendant and DNA found at the crime scene) came from different individuals.

Evidentiary Uses of DNA

Although DNA Analysis is, like state-of-the-art blood testing, actually a form of inclusion/exclusion test, its theoretical potential for extraordinarily high probabilities of establishing identity does represent an impressive development in forensic science. The use of DNA Analysis at trial would greatly expand the class of useful, analyzable crime scene samples. Because an individual's DNA is the

same in all cells regardless of what kind of cells they are,[24] virtually any DNA-containing sample (e.g., hair, blood, semen, skin cells, bone etc.) would be analyzable. Without DNA Analysis, useful biological evidence is limited essentially to blood, semen and saliva.

The new technique would not only increase the kinds of useful evidence, but would also allow for significantly greater flexibility in terms of the condition of evidence to be analyzed. For example, current testing methods do not possess the capability to filter out some of the contamination which quite commonly affects crime scene samples. To illustrate: in the traditional analysis of semen stains, the presence of vaginal secretions and microbial contaminants may make analysis impossible. Using DNA Analysis, however, it is possible to separate sperm (carrying the male's DNA) from other cellular material; thus the contaminants do not interfere with the analysis or its interpretation.[25] Deterioration of samples due to their age is another problem for current testing techniques which will be eliminated in some cases by DNA Analysis; in dry biological samples, DNA may remain intact for years.[26]

There are many obvious advantages of DNA Analysis over traditional means of forensic identification. Fingerprints, for example, are often not found at a crime scene and can also be covered, altered or removed. Similarly, eyewitnesses are often non-existent and their descriptions may lack crucial details. DNA Analysis is of potentially enormous value in criminal proceedings.[27] The question remaining for California appellate courts[28] is whether this new form of scientific evidence is sufficiently reliable for recognition as admissible evidence.

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24. The only difference is in quantity: sperm and ova cells have only one copy of DNA (i.e., these cells contain only a single chromosome) while all other cells contain duplicate copies (i.e., two chromosomes.)

25. *See* Gill, Jeffreys & Warrett, *Forensic Application of DNA "Fingerprints"*, 318 NATURE 577 (1985). Effects of environmental contaminants are also discussed *infra*.

26. *See, e.g.*, Paabo, *Molecular Cloning of Ancient Egyptian Mummy DNA*, 314 NATURE 644 (1985). DNA Analysis has also been utilized in a Pennsylvania homicide investigation to determine whether the internal organs in an exhumed body were in fact the organs belonging to that body, or whether the organs had been switched prior to an autopsy in order to conceal the victim's cause of death; *see* Marx, *DNA Fingerprinting Takes the Witness Stand*, 240 SCIENCE 1616, 1618 (1988).

27. The focus of this comment is on the use of DNA Analysis in a criminal context. The technique promises to have significant impact in the already highly sophisticated area of paternity testing as well. *See* Jeffreys, Brookfield & Semeonoff, *Positive Identification of an Immigration Test Case Using Human DNA Fingerprints*, 317 NATURE 318 (1985); White and Greenwood, *supra* note 6.

28. At the appellate level, only the Florida Court of Appeal has ruled on the admissibility of DNA evidence. Andrews v. Florida, 533 So. 2d 841 (1988). *See also supra* notes 8 and 36.

SCIENTIFIC EVIDENCE

The general purpose of evidence is to shape the fact determining function of a trial, and in order for evidence to contribute to that end it must be reliable.[29] Whenever a party offers evidence possessing an aura of scientific certainty and infallibility[30] and seeks to present that evidence to the jury via the testimony of an impressively credentialed expert,[31] a red flag goes up, calling for evaluation of reliability by the trial judge. Such preadmission screening of novel scientific evidence ensures that a favorable balance will be maintained between probative value and potential prejudice due to jurors' perceptions of "science". Subjecting proposed scientific evidence to an extra measure of scrutiny helps to eliminate the danger that the "aura of infallibility" surrounding such evidence may conceal the fact that it is actually only experimental, tentative and even speculative.[32]

Uniformity of decision is another beneficial consequence.[33] A particular type of scientific evidence will likely be accepted across jurisdictions at more or less the same time based on input from the scientific community,[34] thus eliminating random acceptance based on the case-by-case determinations of trial judges, whose personal assessments of the evidence might vary considerably.[35]

The Kelly/Frye Standard

To gain admissibility in California, scientific evidence must show sufficient reliability to pass the *Kelly/Frye* test.[36] The rule

29. Giannelli, *The Admissibility of Scientific Evidence*, 80 COLUM. L. REV. 1197, 1200 (1980).

30. People v. Kelly, 17 Cal. 3d 24, 32, 549 P.2d 1240, 1245, 130 Cal. Rptr. 144, 149 (1976).

31. *Id.* at 31, 549 P.2d at 1244, 130 Cal. Rptr. at 148.

32. People v. McDonald, 37 Cal. 3d 351, 372-73, 690 P.2d 709, 724, 208 Cal. Rptr. 236, 251 (1984).

33. *Kelly*, 17 Cal. 3d at 31, 549 P.2d at 1244, 130 Cal. Rptr. at 148 (1976).

34. *See infra* note 69 and accompanying text.

35. Stare decisis dictates that appellate endorsement of a particular type of scientific evidence end case-by-case adjudication of admissibility at the trial level. People v. Brown, 40 Cal. 3d 512, 530, 709 P.2d 440, 220 Cal. Rptr. 637 (1985), *rev'd on other grounds sub nom.* California v. Brown, 479 U.S. 538 (1987); *Kelly*, 17 Cal. 3d at 32, 549 P.2d at 1245, 130 Cal. Rptr. at 149 (1976). There are, however, two exceptions to this general rule. First, reliability of the technique as applied is always an appropriate question at trial. *See infra* note 81 and accompanying text. Second, new evidence reflecting a change in the attitude of the relevant scientific community toward the technique in question may warrant reconsideration of the issue of admissibility. *Kelly* at 32, 549 P.2d at 1245, 130 Cal. Rptr. at 149.

36. There are principally two approaches to the evaluation of scientific evidence. Like California, most jurisdictions have adopted some form of the standard proposed in Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923), discussed in detail *infra*. The alternative

originated in *Frye v. United States*,[37] an early case involving the use of polygraph tests in which the court reasoned:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

In 1976, the California Supreme Court reiterated its express adoption of the *Frye* approach in *People v. Kelly*.[38] In *Kelly*, the voiceprint analysis used to identify the defendant failed to satisfy the three-part test for admissibility of scientific evidence:

1. The *Kelly/Frye* test requires that the reliability of the *method* used to obtain the scientific evidence be established. As the *Frye* court set forth, the proponent of the evidence can demonstrate its reliability by showing "general acceptance in the relevant scientific community."[39] Generally, acceptance of a technique will be shown by expert testimony, which becomes the second part of the *Kelly/Frye* analysis.

2. The *qualifications* of the testifying expert(s) must be established, as well as their ability to assess "general acceptance" accurately and impartially.

3. The evidence must also be reliable *as applied*. This third

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test (often associated with Professor McCormick) is based on relevancy, not general acceptance. Scrutiny of scientific evidence under the "relevancy approach" is less strict than under *Kelly/Frye*, as the relevancy standard for admissibility is merely a favorable balance of probative value versus prejudicial effect. In approving the admissibility of DNA Analysis in Andrews v. Florida, the Florida Court of Appeal applied the relevancy approach, rejecting the *Frye* general acceptance standard. 533 So. 2d at 846 (1988). For further discussion of the relevancy test, *see* Coppolino v. State, 223 So. 2d 68 (Fla. Dist. Ct. App., 1968), *cert. denied*, 399 U.S. 927 (1970); *see also* Giannelli, *supra* note 21 at 1232. The passage by California voters of Proposition 8, which mandates that "relevant evidence shall not be excluded in any criminal proceeding," appears directly to conflict with California's retention of the stricter "general acceptance" standard. Some confusion exists as well as to what the standard for admissibility is under the Federal Rules of Evidence. Federal courts applied the *Frye* test prior to the adoption of the Federal Rules in 1975, however because the Rules are silent as to the general acceptance standard, some courts and commentators assume that *Frye* remains the standard, while others reject this view. *See* Giannelli, *supra* note 29, at 1228. *But cf.* United States v. Downing, 753 F.2d 1224 (3d Cir. 1985).

37. 293 F. 1013 (D.C. Cir. 1923).

38. 17 Cal. 3d at 30 (1976).

39. Giannelli, *supra* note 29, at 1201. Another way of looking at the question of reliability is to think of evaluating the validity of the underlying scientific principles and then analyzing how well the method reflects those principles.

element is both a component of the *Kelly/Frye* test and an area for continuing scrutiny. After a particular type of scientific evidence has been accepted by the courts as generally reliable, this part of the analysis remains a requirement to be addressed on a case-by-case basis.[40] Except in cases where the administration of the technique is shown to be so substandard as to render the results inadmissible, the evaluation of the application of the method in any given case will probably be for the trier of fact rather than the court (i.e., it will become a question of weight and no longer one of admissibility.)

In any examination of the *Kelly/Frye* test, it is important to keep in mind that the issue is *admissibility*, not proof or weight of the evidence.[41] The question to focus on is whether the scientific evidence should be assigned *any* weight whatsoever, not how much weight it should be given once threshold reliability has been established.

What Is and Is Not Considered Scientific Evidence?

Examples of techniques to which *Kelly/Frye* has been applied in the past decade include bite-mark identification,[42] analysis of footprints/shoeprints,[43] the use of a scanning electron microscope to detect gunshot residue,[44] electrophoretic testing[45] of dried bloodstains[46] and dried semen stains,[47] breathalyzer tests[48] and hypnosis.[49] As a general rule, *Kelly/Frye* is not applied to testimony by experts with regard to medical, psychological or psychiatric techniques,[50] however some recent exceptions exist.[51] In line with this

40. *See infra* note 81 and accompanying text.

41. People v. Marx, 54 Cal. App. 3d 100, 110-11, 126 Cal. Rptr. 350, 356 (1975).

42. People v. Slone, 76 Cal. App. 3d 611, 143 Cal. Rptr. 61 (1978). Bite-mark identification utilizes models, photos, X-rays and comparisons of slides of the victim's wounds with the defendant's teeth.

43. People v. Puluti, 120 Cal. App. 3d 337, 174 Cal. Rptr. 597 (1981). This is also known as "Cinderella analysis".

44. People v. Palmer, 80 Cal. App. 3d 239, 145 Cal. Rptr. 466 (1978).

45. Electrophoresis, accepted by the court in People v. Brown, 40 Cal. 3d 512, 709 P.2d 440, 220 Cal. Rptr. 637 (1985), *rev'd on other grounds sub nom.* California v. Brown, 479 U.S. 538 (1987), is a technique which is very similar to DNA Analysis in that it involves the identification of proteins based on their behavior when placed in an electrically-charged gel slab. *See generally* HARTL *supra* note 11, at 353.

46. People v. Reilly, 196 Cal. App. 3d 1127, 242 Cal. Rptr. 496 (1987).

47. *Brown*, 40 Cal. 3d 512, 709 P.2d 440, 220 Cal. Rptr. 637 (1985).

48. *See* People v. Adams, 59 Cal. App. 3d 559, 131 Cal. Rptr. 190 (1976).

49. People v. Shirley, 31 Cal. 3d 18, 641 P.2d 775, 181 Cal. Rptr. 243 (1982).

50. People v. McDonald, 37 Cal. 3d at 351, 690 P.2d 709, 209 Cal. Rptr. 236 (1984); *see also* People v. Gray, 187 Cal. App. 3d 213, 231 Cal. Rptr. 658 (1986); People v. Mendibles, 199 Cal. App. 3d 1277, 245 Cal. Rptr. 553 (1988).

51. For example, in People v. Bledsoe, 36 Cal. 3d 236, 681 P.2d 291, 203 Cal. Rptr. 450

general rule is the court's refusal to apply *Kelly/Frye* to dog tracking,[52] distinguishing "electronic gadgetry" from animate sources of evidence, whose reliability should be evaluated on a case-by-case basis.[53] The important distinction between expert testimony about scientific subjects (or, as in this case, about scientific evidence) and the scientific evidence itself was articulated by the California Supreme Court in *People v. McDonald*:[54]

> When a witness gives his personal opinion on the stand—even if he qualifies as an expert—the jurors may temper their acceptance of his testimony with a healthy skepticism born of their knowledge that all human beings are fallible. But the opposite may be true when the evidence is produced by a machine: like many laypersons, jurors tend to ascribe an inordinately high degree of certainty to proof derived from an apparently "scientific" mechanism, instrument, or procedure.

The effect of "science" on jurors' abilities to fairly assign weight to particular evidence is a recurring theme in any discussion of *Kelly/Frye* and is one of the considerations at the heart of preadmission scrutiny of scientific evidence.

DNA Analysis and Current *Kelly/Frye* Standards

Admissibility of scientific evidence is a question of law for the court and is thus subject to appellate review, even though it may involve preliminary determinations of fact.[55] The proponent of DNA evidence, bearing the proof burden,[56] must be prepared to demonstrate to the satisfaction of the trial judge that the evidence is reliable by *Kelly/Frye* standards and that its probative value is not outweighed by its potential prejudicial effect. Each element of the *Kelly/Frye* test will be discussed here in light of recent judicial interpretations and applications, with an eye toward examining the strengths and weaknesses of the case for admission of DNA evidence in California trials. Throughout the discussion it will be important for the reader to bear in mind that the question for the

(1984), the psychological phenomenon of "Rape Trauma Syndrome" was subjected to *Kelly/Frye* analysis when the prosecution sought to introduce the syndrome as evidence that the complaining witness had in fact been raped. Used for that purpose, evidence of rape trauma syndrome (in the form of expert testimony) was not found to have gained general acceptance under *Kelly/Frye*.

52. People v. Craig, 86 Cal. App. 3d 905, 150 Cal. Rptr. 676 (1978).

53. *Id.* at 914, 150 Cal. Rptr. at 682.

54. 37 Cal. 3d 351, 372 (1984).

55. People v. King, 266 Cal. App. 2d 437, 443, 72 Cal. Rptr. 478, 482 (1968); CAL. EVID. CODE §§ 310(a), 402(c), 405(a) (Deering 1986).

56. *Shirley*, 31 Cal. 3d at 54, 641 P.2d at 796, 181 Cal. Rptr. at 265 (1982).

court is not whether DNA Analysis is reliable as a matter of scientific fact, but rather whether it is generally accepted as reliable by the relevant scientific community.[57]

General Acceptance in the Relevant Scientific Community

There are two significant questions to ask at this stage in the analysis: What constitutes the "relevant" scientific community?; and, what degree of acceptance will be considered "general"?

Turning to the first of these questions, it appears that courts will take a relatively broad view. The use of electrophoretic analysis of dried bloodstains in *People v. Reilly*[58] presents a case comparable to DNA Analysis, not only because of the similarities in the two techniques, but also because few scientists have occasion to use the techniques for forensic identification, that is, on specimens which have not been extracted and maintained under ideal laboratory conditions.[59] Do only those few forensic scientists make up the "relevant" community? The *Reilly* court said no, and viewed the relevant community as including scientists from broader disciplines who were knowledgeable about other applications of electrophoretic blood typing.[60] This would suggest that the opinions of scientists who use DNA in non-forensic areas (e.g., prenatal screening for genetically transmitted diseases and other diagnostic uses, testing for the presence of organisms in commercial food preparation, AIDS research and diagnosis) could be considered when evaluating the technique's "general acceptance." The relevant community under this theory might even encompass medical and academic experts.

The California Supreme Court has established an important limit, however. In *People v. Bledsoe*,[61] where testimony regarding Rape Trauma Syndrome was not admitted as evidence that a rape had in fact occurred, the court drew a sharp distinction between therapeutic and forensic uses of the syndrome. The court stated that its ruling was "not intended to suggest that rape trauma syndrome is not generally recognized or used in the general scientific community from which it arose, but only that it is *not relied on in that community for the purpose for which the prosecution sought to use it in this case.*" (Emphasis added.)[62] In other words, the in-

57. *Id.* at 55, 723 P.2d at 1376, 181 Cal. Rptr. at 265. The emphasis here is on acceptance of the technique's *forensic use*, rather than its validity as a general proposition.

58. 196 Cal. App. 3d at 1136, 242 Cal. Rptr. at 501 (1987).

59. *Id.* at 1138, 242 Cal. Rptr. at 502.

60. *Id.*

61. 36 Cal. 3d 236, 681 P.2d 291, 203 Cal. Rptr. 450 (1984).

62. *Id.* at 251, 681 P.2d at 301, 203 Cal. Rptr. at 460.

quiry must focus on both the make-up of the community and the technique's use within that community. This interpretation of the relevant community emphasized the context in which a technique comes to be "generally accepted."

Context should play an important role in *Kelly/Frye* analysis. The purpose of the rule is to screen out unreliable scientific evidence, that is, to ensure that evidence admitted at trial is worthy of *some* weight—however small—to aid the jury in its determination of the facts.[63] Scientific evidence should be reliable as just that: evidence. To what degree does the acceptance of DNA Analysis by scientists working with non-degraded specimens for non-forensic purposes indicate *evidentiary* reliability? Is acceptance of the analysis as used on laboratory samples relevant to the question of acceptance of the technique when applied to crime scene samples?

Another contextual consideration arises because the primary use of DNA evidence would be in criminal trials, more specifically, in rape and homicide, including capital cases. Due process and general notions of fairness to criminal defendants demand that scientific evidence introduced by the prosecution be at the very least trustworthy in terms of its accuracy.

Context can also be helpful in measuring the trustworthiness of scientific evidence, in this case by examining the non-forensic standards applied to the technique in question. For example, the accuracy of a blood test for medical purposes is often a matter of life and death, as a mistake could lead to a transfusion of the wrong type. Acceptance of a blood typing technique within the non-forensic medical community would thus indicate great trustworthiness in other contexts as well, since no use could demand greater accuracy than a life or death situation. Can the same be said of the non-forensic contexts in which DNA Analysis is used? This is a question which should be given some attention by the court in its determination of the relevancy of a broader scientific community's acceptance of a technique in establishing that technique's acceptance by the narrower forensic community.

The remaining question regarding "general acceptance in the relevant scientific community" is, how should the trial court determine whether acceptance of DNA Analysis is sufficiently general? The *Kelly* court emphasized the importance of hearing the views both of proponents of a technique *and* those who oppose or ques-

63. Pre-screening also guards against jurors giving far greater weight to particular evidence than is warranted by its reliability or actual probative value. *See* CAL. EVID. CODE § 352 (Deering 1986).

tion it.[64] So important is the notion of a "fair fight" in California that trial courts are vested with the power to appoint expert witnesses *sua sponte*.[65] When applied to *Kelly/Frye*, this enables the judge to take affirmative steps in accurately ascertaining the views of the relevant scientific *community*, not being limited to the views of those experts produced by the parties. The trial court may also consider scientific or legal literature relating to the technique's use or acceptance,[66] further promoting active investigation by the court. The focus of the trial court when evaluating such expert testimony and outside literature is perhaps not so much acceptance, but significant *opposition* to the proposed use of the technique.[67] Acceptance by courts in other jurisdictions may also be relevant,[68] bearing in mind, however, that *Kelly/Frye* requires acceptance by the scientific, not legal, community.[69]

A significant determination in applying the "general acceptance" standard to DNA Analysis will be whether it should be considered a wholly new technique or merely a new use of well-established component techniques, each of which is itself "generally accepted." Once again, context should play an important role in deciding whether, for example, general, non-forensic acceptance of any part of the process involved in DNA Analysis is at all relevant to acceptance of the entire process for forensic purposes.

Who May Qualify As an Expert?

The next step in establishing the reliability and probative value of DNA Analysis under *Kelly/Frye* concerns the qualifications of the expert witnesses testifying with regard to general acceptance. It is important to remember that the focus of expert testimony in the *Kelly/Frye* context should be whether the technique enjoys general acceptance, not whether it is based on sound scientific principles. The testimony of an expert possessing a wealth of knowledge about molecular genetics and DNA may not be relevant to the question of DNA's use and acceptance among forensic scientists. Of course, an expert's academic qualifications and familiarity with the principles and technology underlying a particular technique are indispensable; the point being stressed here is simply that these alone are not enough to qualify him or her to provide relevant testimony on the

64. *Kelly*, 17 Cal. 3d at 37, 549 P.2d at 1248-49, 130 Cal. Rptr. at 152-53 (1976).
65. CAL. EVID. CODE § 730 (Deering 1986).
66. *Kelly*, 17 Cal. 3d at 35, 549 P.2d at 1247, 130 Cal. Rptr. at 151 (1976).
67. *Shirley*, 31 Cal. 3d at 56, 641 P.2d at 797, 181 Cal. Rptr. at 265-66 (1982).
68. *See supra* note 8.
69. *Reilly*, 196 Cal. App. 3d at 1135, 242 Cal. Rptr. at 500 (1987).

question of general acceptance.[70] Whether an expert is qualified to testify to general acceptance under *Kelly/Frye* is a question which is heavily influenced by how the court measures the boundaries of the "relevant scientific community." While the trial judge is given broad discretion in determining the qualifications of an expert,[71] the judge must be careful to distinguish and limit the witness' field of expertise.[72] In other words, there must be a good match between the witness' background and the scientific community whose acceptance of the technique has been deemed relevant.

Another key qualification is impartiality.[73] However, like the question of membership in the "relevant" community, there exists some latitude in assessing an expert's ability to be objective. The fact that DNA Analysis is performed at present by only three laboratories[74] in the United States gives rise to the danger that the only experts truly qualified to comment on its forensic use and acceptance have proprietary or other interests in its judicial acceptance. This is not as great a problem as it might appear, however, as personal interest in the success of the technique does not in and of itself preclude an expert from testifying about its acceptance.[75] Personal interest will be found intolerable only when there is a *single* expert testifying as to *general* acceptance.

The 1987 case *People v. Reilly*[76] provides a good prediction of how DNA Analysis will fare on this question. In *Reilly*, the technique in question was electrophoretic testing of dried bloodstains,[77] an identification test similar to DNA Analysis as to some of the technology involved and as to the individuals qualified to offer expert testimony on *Kelly/Frye* issues.[78] In addressing the question of an expert witness' interest, the court distinguished a tolerable degree of professional interest in a technique's acceptance from that

70. *Kelly*, 17 Cal. 3d at 39, 549 P.2d at 1250, 130 Cal. Rptr. at 154 (1976). Whether a particular person qualifies as an expert is a determination to be made on a case-by-case basis. *See generally* CAL. EVID. CODE § 720(a) (Deering 1986).

71. *Kelly*, 17 Cal. 3d at 39, 549 P.2d at 1250, 130 Cal. Rptr. at 154 (1976).

72. *Id.* at 39, 549 P.2d at 1250, 130 Cal. Rptr. at 154 (quoting People v. King, 266 Cal. App. 2d 437, 445, 72 Cal. Rptr. 478, 483 (1968).)

73. People v. Brown, 40 Cal. 3d at 530, 709 P.2d at 448, 220 Cal. Rptr. at 645 (1985), *rev'd on other grounds sub nom.* California v. Brown, 479 U.S. 538 (1987); *Kelly*, 17 Cal. 3d at 38, 549 P.2d at 1250, 130 Cal. Rptr. at 154 (1976).

74. This will not long remain the situation. DNA Analysis capability is presently being developed in the public sector, notably by the Federal Bureau of Investigation, the State of Virginia and Dade County (Miami), Florida.

75. *Reilly*, 196 Cal. App. 3d at 1139, 242 Cal. Rptr. at 503 (1987).

76. 196 Cal. App. 3d 1127, 242 Cal. Rptr. 496 (1987).

77. *See supra* note 45.

78. *Reilly*, 196 Cal. App. 3d at 1139-40, 242 Cal. Rptr. 504-05 (1987).

which was problematic in *Kelly*, for example, where the sole expert witness testifying to general acceptance of voiceprint analysis was a leading proponent of the technique who had "built his career" on its reliability.[79] The picture which emerges with regard to an expert's impartiality is that personal interest in the technique's acceptance will not prevent scientists involved in the development or employment of DNA Analysis from qualifying as *Kelly/Frye* expert witnesses. So long as personal interest can be "distributed" onto the combined testimony of a fair number of experts representing a cross-section of the relevant scientific community, the courts will probably be tolerant of a degree of bias which would render a sole spokesperson unreliable on the issue of general acceptance.

The final aspect in assessing the qualifications of experts involves drawing a distinction between "mere" technicians and "qualified" scientists, in other words distinguishing know-how from "know-why". Technicians whose sphere of personal knowledge extends no further than following prescribed routines are thought unqualified to establish the validity of a new technique.[80] This determination must be made on a case-by-case basis, however, as there may be "technicians" whose background and forensic work meet *Kelly/Frye* standards, and "scientists" whose familiarity with theoretical principles is too far removed from the forensic context to be of value for *Kelly/Frye* purposes. The DNA analyst is an excellent example of the former based on two considerations. First, the technology involved in DNA Analysis demands that analysts performing the test possess significant understanding of underlying principles (e.g., holding degrees in molecular biology or closely related fields.) Second, the work of forensic laboratory personnel exceeds the responsibility of the average technician's role in performing scientific tests. The DNA analyst is involved in more decision-making (e.g., data interpretation) and less routinization than technicians performing other laboratory tasks. This will probably prove quite helpful in terms of a *Kelly/Frye* test: analysts testifying as experts would enlarge the cross-section of the scientific community offering views on general acceptance, providing a more meaningful opportunity for the court to learn of opposition or reservations about the technique, while at the same time helping to dissipate individual experts' personal interests in the technique's acceptance.[81]

79. *Kelly*, 17 Cal. 3d at 38, 549 P.2d at 1249, 130 Cal. Rptr. at 153 (1976).

80. *Id.* at 39, 549 P.2d at 1250, 130 Cal. Rptr. at 154; Giannelli, *supra* note 29, at 1214.

81. It is important to note that *all* evidence which purports to establish the presence of

Reliability of the Technique As Applied

The third of three parts in the *Kelly/Frye* analysis focuses not on theoretical reliability, but on actual reliability: should the scientific evidence presented be admitted *in the specific case* at hand? This question presents entirely different problems for DNA Analysis than did the question of "general acceptance". In fact, due to the inherent complexity of the technique and the heightened role of the technician, DNA Analysis may find its greatest challenge to admissibility here.

Inquiry in the area of reliability "as applied" involves basically two considerations. First, how well or poorly the test was performed; second, to what extent deterioration or contamination of the biological evidence may have affected the test results. With regard to the first of these, DNA Analysis provides even the most competent analyst with many opportunities for human error. For example, at every stage in the procedure involving a transfer of all or part of the sample from one container or mixture into another, the opportunity exists for mislabeling, mismeasurement or accidental contamination. Errors in perception or documentation of results are also possible.[82] The possibility of erroneous identifications due to mistakes by lab personnel is a fertile area for challenging the validity of DNA evidence.[83] Because technicians involved in DNA Analysis are called upon to interpret as well as produce test results, an individual's training and experience in performing the test will be a focus of this inquiry as well.[84] In general, however, the question whether a particular test was competently executed has no spe-

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a defendant at a crime scene (or, in the case of paternity testing, within a child's genetic make-up) will always be subject to analysis of how reliably the technique was applied in making the identification. In other words, this inquiry is not limited to the *Kelly/Frye* context. The distinction must be made, however, between pre- and post-acceptance scrutiny. In the latter, the possibility of error in the application of a technique is no longer a question of admissibility, but rather goes to the weight accorded that evidence. People v. Farmer, 47 Cal.3d 888, 913, 765 P.2d 940, 956, 254 Cal. Rptr. 508, 524 (1989); People v. Palmer, 80 Cal. App. 3d at 253, 145 Cal. Rptr. at 472-73 (1978).

82. The cause of most laboratory errors in DNA Analysis is the mix-up of samples. Most labs have procedures for avoiding mix-ups as part of their overall quality assurance programs.

83. Special attention should be paid to the quality control procedures of any laboratory performing DNA Analysis. The need for adequate means of error detection was acutely demonstrated by the results of a recent study from the California Association of Crime Lab Directors. In blind sample tests given to the three private labs currently performing DNA Analysis, only one of the three correctly matched all the samples. Both of the other labs produced one incorrect match out of approximately 50 samples. Even proponents of the technique agree that such a high rate of error is unacceptable. *See* Thompson, *The Myth of DNA Fingerprints*, CALIFORNIA LAWYER, April 1989, at 34.

84. *Reilly*, 196 Cal. App. 3d at 1138, 292 Cal. Rptr. at 503 (1987).

cial application in the case of DNA Analysis. An evaluation of the DNA analyst's care and skill will follow much the same lines as in an evaluation of other kinds of tests (e.g., blood, breathalyzer etc.)

New questions appear in the evaluation of the condition of evidence found at a crime scene and effects it might produce on the test's outcome.[85] Of particular concern will be the effects of aging, drying, temperature and contamination from foreign organic substances (i.e., substances containing their *own* DNA.) A significant problem would arise if any of these factors were to cause a change in DNA which could go undetected, producing an inaccurate result rather than no result at all. The response from proponents (including many researchers) is that DNA tends to "go away" when damaged, rather than change type. Thus, environmental damage sufficient to cause a structural change would likely yield no result or at least a result so irregular as to make it both immediately suspect and—more important—virtually unmatchable to any DNA sample taken directly from a defendant. If true, this cuts in favor of defendants. Due to the irregular and unmatchable result which would be obtained, a crime scene sample in questionable condition would tend to produce false exclusion rather than false inclusion.

Environmental effects on DNA and on the accuracy of DNA Analysis are the subject of a great deal of current research. Although the lack of extensive information in this area remains one of the strongest arguments against admissibility, proponents maintain that sufficient research data already exist to preclude inexplicable test results because DNA's deterioration and contamination by particular substances can be defined in terms of known chemical processes. As for the more realistic situation, where crime scene DNA has been exposed to any number of unknown environmental factors, researchers point out that it is unnecessary to know precisely what has happened to a sample because circumstances and the environment itself limit the range of possible exposure. For example, we know as a general proposition that samples found anywhere in the United States will not have been exposed to temperatures greater than 150° F in the absence of highly unusual circumstances. But what of those cases where such circumstances do exist?[86]

85. Discussion of this issue with regard to electrophoretic testing is found in *Brown*, 40 Cal. 3d 512, 530, 709 P.2d 440, 448, 220 Cal. Rptr. 637, 645 (1985) and *Reilly*, 196 Cal. App. 3d 1127, 1150, 242 Cal. Rptr. 496, 511 (1987).

86. Consider, for example, the 1988 Kansas homicide trial in which DNA Analysis of blood found on the side of a crematorium oven was used to connect the victim's remains with the scene of the murder. *See* Michaud, *supra* note 5 at 88.

Questions such as this may be beyond the scope of *Kelly/Frye*, as they arguably affect the weight given to DNA evidence in a particular case rather than the admissibility of DNA evidence generally. Nonetheless, the issue of environmentally damaged samples is one which will continue to bear upon the use of DNA Analysis even after various forms of the technique[87] are deemed admissible. Prosecution and defense alike should remain alert to the many issues surrounding reliability "as applied", both as they relate to *Kelly/Frye* and for the purpose of impeaching DNA evidence once admitted.

PROBLEMS OF ADMISSIBILITY BEYOND *KELLY/FRYE*

DNA Analysis raises some unique questions which could affect its admissibility despite a showing of "general acceptance". Because of the highly technical nature of DNA Analysis, the danger exists that its probative value will be outweighed by the consequences of its complexity.[88] Consider, for example, the undue time consumption which might result from a "battle of the expert witnesses" on the subject of how much weight DNA Analysis should receive given the circumstances of a particular test (e.g., condition of the sample, conclusiveness of the result etc.) Inflated representations about the test's accuracy and infallibility might lead to a similar debate among experts. Clearly, some degree of agreement as to the technique's basic reliability must exist within the *legal* community as well as the scientific community if extravagant arguments about peripheral issues are to be avoided at trial.

Parties seeking to introduce DNA evidence must also be mindful of the temptation to take advantage of lay jurors' tendency to give "considerable weight to 'scientific' evidence . . . presented by 'experts' with impressive credentials."[89] Substantial prejudice may also arise because of jurors' inability to question meaningfully the results of DNA Analysis based on anything other than the arguments presented by the parties. "Common sense", the traditional dominion of the jury,[90] is of minimal use in the evaluation of bio-

87. As noted earlier (*supra* note 18), the RFLP technique described in this comment is but one of several and potentially many techniques for identifying an individual based on DNA. The area of forensic science which identifies individuals on the basis of their DNA is still at a formative stage. We can anticipate the emergence of new methods of DNA Analysis in the future, analogous to developments in the area of bloodtesting in recent decades.

88. CAL. EVID. CODE § 352 (Deering 1986).

89. *Kelly*, 17 Cal. 3d at 31, 549 P.2d at 1245, 130 Cal. Rptr. at 149 (1976).

90. The very existence of the jury and its role in assigning weight to the evidence admitted at trial is one of the most fundamental notions of our legal system, and perhaps the most

chemical and statistical principles beyond the scope of common understanding. The danger is, of course, that lay jurors will be so overwhelmed by sophisticated scientific explanations of the evidence presented that they will abandon their fact-finding responsibilities, opting simply to defer to the judgment of "experts" who "really understand" what the evidence means.[91] DNA Analysis is particularly susceptible to producing this result. Unlike bite-mark identification[92] or shoeprint analysis,[93] where the jury can use its own powers of observation to *see* the models, X-rays, plaster casts etc. used to arrive at a particular conclusion, DNA evidence is based on biochemical observations which cannot be conceptualized on the basis of jurors' *own* experience or intuition.[94]

This is not to say, however, that complexity necessarily leads to juror confusion. Highly sophisticated methods of blood testing, also beyond the common knowledge of lay jurors, have been accepted by courts for many years without destroying the ability of juries to render meaningful verdicts in cases where such tests have been utilized. This fact speaks well for jurors' patience with scientific evidence and for attorneys' willingness to make the evidence understandable. However, patience alone will not make DNA evidence comprehensible. While it is not necessary that jurors understand all of the intricate details of DNA Analysis, they must be given sufficient information to fairly assign it weight relative to all other evidence presented in a given case. A verdict based largely on evidence which was either beyond jurors' comprehension or misunderstood would arguably violate a criminal defendant's right to due process. This danger does exist with DNA Analysis, and will be amplified if courts are willing to admit DNA evidence despite many uncertainties.

The idea that as yet unresolved issues should affect only the weight of the evidence and not its admissibility demands too much of future jurors. Foreseeable weaknesses in DNA Analysis should

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striking difference between trials under Common Law and Civil Law. *See, e.g.*, GRUNDGESETZ [GG] § 103 (W. Ger.); ZIVILPROZESSORDNUNG [ZPO] §§ 313, 139 (W. Ger.). Care must be taken to prevent increasingly complex scientific evidence from becoming "self-validating", thereby usurping the jury's function.

91. People v. Marx, 54 Cal. App. 3d 100, 111, 126 Cal. Rptr. 350, 356 (1975) (citing People v. Collins, 68 Cal. 2d 319, 332 (1968).)

92. *Marx*, 54 Cal. App. 3d 100, 126 Cal. Rptr. 350 (1975).

93. People v. Puluti, 120 Cal. App. 3d 337 (1981); *see also* People v. Barker, 113 Cal. App. 3d 743 (1980) *ordered depublished, printed unofficially only* at 170 Cal. Rptr. 69 (1980).

94. Although this factor was not a bar to admission under the relevancy approach, the Florida Court of Appeal did note that this aspect of DNA evidence "requires courts to proceed with special caution." 533 So. 2d at 850 (1988).

be adequately addressed *prior* to the technique's acceptance, rather than being left to the discretion of lay jurors when those weaknesses actually do arise. In addition, there is some fundamental unfairness in the idea that different juries could produce wholly inconsistent and irreconcilable results because weight was assigned based on guesswork instead of reason.

The fact that DNA Analysis will most often be used to identify the perpetrator of a crime warrants extra restraint in its admission.[95] As one court has observed, "A courtroom is not a research laboratory. The fate of a defendant in a criminal prosecution should not hang on his ability to successfully rebut scientific evidence which bears an 'aura of special reliability and trustworthiness'."[96] The key to a fair fight lies in adequate exploration of the technique's limitations—not merely its capabilities—so that warranted rebuttal of DNA evidence will not be precluded by sheer lack of information. A special responsibility rests on the legal community. Lawyers must take time to learn how to scrutinize DNA evidence so that its admission is not permitted to go unchallenged.

PROPOSALS

What follow are suggestions regarding the admission and future use of DNA Analysis. They are based in part on the treatment of roughly analogous forms of scientific evidence by courts and the legislature in recent years.

A Name Change

The popular name "DNA Fingerprint" should be eliminated from courtroom use. Originators of the technique called it a "fingerprint" based on the term's common *scientific* usage (referring generally to a complex pattern of uniquely identifying features.) The problem here is that the term "fingerprint" has a much more narrow usage in a *legal* context. To state the problem another way, jurors have pre-existing notions about the sources and significance of traditional fingerprints which should not be simply transferred to a DNA "fingerprint".

The fate of the polygraph test in California[97] is an example of the impact of a popular name. Compounding the polygraph's per-

95. *Kelly*, 17 Cal. 3d at 32, 549 P.2d at 1245, 130 Cal. Rptr. at 149 (1976); People v. Collins, 68 Cal. 2d 319, 332 438 P.2d 33, 39, 66 Cal. Rptr. 497, 505 (1968).

96. United States v. Brown, 557 F.2d 541, 556 (6th Cir. 1977).

97. CAL. EVID. CODE § 351.1 (Deering 1986).

sistent reliability problems[98] was the perceived prejudicial effect of the term "lie detector." Largely in response to the 1982 passage of Proposition 8, the "Victims' Bill of Rights",[99] the State Legislature added section 351.1 to the Evidence Code in 1984 to ensure that polygraph results, which in addition to being of questionable value had come to be known as "lie detectors", would be inadmissible in criminal proceedings.

Statutory Control

The mandate of Proposition 8, that no relevant evidence be excluded from a criminal proceeding, could have significant impact on the use of DNA evidence. Because even evidence of somewhat questionable integrity could be considered "relevant" by Proposition 8 standards, foresight should be exercised on the part of the State Legislature so as to prevent or restrict the admission of "relevant" but arguably unreliable kinds of evidence.[100] As set forth within the language of Proposition 8,[101] this can be accomplished through legislation enacted by a two-thirds vote of both the Senate and the Assembly. Because of the potential prejudicial effects of DNA Analysis, the development of sound legislation to guide its future use as evidence may be an appropriate precaution.

The treatment of testimony under hypnosis in the California Evidence Code[102] provides a model.[103] Section 795 sets forth sharply limited conditions under which posthypnotic testimony will be admitted in criminal proceedings. The primary benefit of enacting a similar set of guidelines for the use of DNA Analysis would be the promotion of uniformity in admissibility and interpretation.

98. *See, e.g.*, People v. Carter, 48 Cal. 2d 737, 312 P.2d 665 (1957); People v. Jones, 52 Cal. 2d 636, 343 P.2d 577 (1959).

99. CAL. CONST. art. I, § 28, added by initiative measure June 8, 1982. Proposition 8 provides, *inter alia*: "(d) Right to Truth-in-Evidence. Except as provided by statute hereafter enacted by a two-thirds vote of the membership in each house of the Legislature, relevant evidence shall not be excluded in any criminal proceeding. . ."

100. The relevancy approach to the admission of scientific evidence is discussed *supra* note 36.

101. CAL. CONST. art. I, § 28.

102. CAL. EVID. CODE § 795 (Deering 1986 & Supp. 1989).

103. The enactment of Evidence Code § 795 in 1984 was probably prompted by passage of Proposition 8 (*supra* note 99). Although the California Supreme Court determined that testimony obtained using hypnosis was unreliable in People v. Shirley, 31 Cal. 3d 18, 641 P.2d 775, 181 Cal. Rptr. 243 (1982), Proposition 8 nonetheless threatened to make such evidence admissible based on some degree of relevance despite a margin of unreliability. The legislative response was to enact this Evidence Code provision which has the twofold effect of *permitting* the use of hypnosis under specified circumstances, while at the same *preventing* its use under any but those conditions.

Statutory regulation is especially warranted in light of the seriousness of the criminal cases in which DNA evidence will be typically presented.

There are, however, drawbacks to the use of overly tight statutory control. Because DNA Analysis remains a developing forensic tool, the techniques employed are likely to undergo refinements and changes which would make such legislation quickly obsolete. One solution might be to create a statute which includes a "sunset provision" (i.e., one which will automatically be subject to review, revision, or repeal at the close of a specified period.) Another danger posed by a statute is the creation of undue bureaucracy surrounding use of the technique. Consider, for example, the *sixteen pages* of regulations governing breathalyzer tests contained in the California Administrative Code.[104] "Title 17" lays out specific regulations for virtually every phase of forensic breath alcohol analysis, including laboratory maintenance, licensing, personnel, record keeping, the collection and handling of samples, as well as the procedures used in the analysis itself.[105] To avoid saddling DNA Analysis with similarly rigid (and potentially obsolete) rules, drafters of a statutory provision should take care to focus on the legal issues concerning admissibility and courtroom use, rather than attempting to regulate the specific laboratory processes involved in creating DNA evidence.

Jury Instructions

A *sua sponte* instruction[106] should be required in any proceeding where DNA evidence has been admitted. The purpose of the instruction is to remind jurors that DNA Analysis alone does not prove a defendant's guilt, but rather produces evidence which is to be weighed along with all other evidence in reaching their verdict. It should be explained that DNA Analysis linking the defendant to the crime scene and/or to the victim is merely associative evidence, which may be rebutted by the defendant's explanation of circumstances surrounding the presence of his or her DNA (i.e., hair, blood etc.) at a particular place. The instruction could also significantly reduce the problem of too much deference to expert testimony (if introduced post-*Kelly/Frye*) by reminding jurors that such

104. CAL. ADMIN. CODE tit. 17, §§ 1215-1222.2 (1985).

105. *See also* People v. Adams, 59 Cal. App. 3d at 562, 131 Cal. Rptr. at 192 (1976).

106. A *sua sponte* jury instruction is one which the judge must give under prescribed circumstances whether or not it has been requested by either party.

testimony is designed to aid them in their determination of the facts, not to make that determination for them.

An example of a jury instruction to be given *sua sponte* in every criminal case[107] is section 2.27 of California Jury Instructions—Criminal (CALJIC), regarding the sufficiency of the testimony of one witness. Important information contained in any statutory provisions regarding DNA Analysis could also be brought to the attention of the jury in a *sua sponte* instruction. For example, the definition of an accomplice and restrictions on accomplice testimony as codified in section 1111 of the California Penal Code must be presented to the jury in cases where this information is applicable.[108] The language of Penal Code section 1111 appears virtually verbatim in CALJIC sections 3.10 and 3.11.[109] Jury instructions in combination with Evidence Code provisions[110] would ensure that the use of DNA Analysis in courtroom proceedings is kept within its appropriate bounds.

The Statistical Basis for Evaluation

Population studies to establish gene frequencies must be more extensive. The results of DNA Analysis are interpreted according to how frequently (or, more appropriately, how rarely) particular restriction fragment lengths appear in relevant population groups. At this time, population data remain to some extent speculative because of insufficient opportunity for the DNA typing of a large number of individuals.[111] The use of unreliable statistics in the interpretation of DNA evidence gives rise to probabilities lacking foundation, similar to those condemned in *People v. Collins*.[112] A positive step toward providing population data has already been taken in California. A law passed in 1985 mandates that all convicted sex offenders must provide blood and saliva specimens at the time of their release from prison. While the articulated purpose of this requirement is to establish a data bank of DNA typing (a high-tech version of "mug shot" collections), it will have the added bene-

107. People v. Rincon-Pineda, 14 Cal. 3d 864, 884, 538 P.2d 247, 261, 123 Cal. Rptr. 119, 133 (1975).

108. People v. Gordon, 10 Cal. 3d 460, 470, 516 P.2d 298, 304, 110 Cal. Rptr. 906, 912 (1973); People v. Bivens, 54 Cal. 2d 71, 76, 351 P.2d 776, 779, 4 Cal. Rptr. 504, 507 (1960).

109. *See also* CALJIC sections 3.12, 3.16, 3.18.

110. *See infra* text accompanying note 102.

111. Sensabaugh, *supra* note 10 at 394.

112. 68 Cal. 2d 319, 438 P.2d 33, 66 Cal. Rptr. 497 (1968); *cf.* People v. Marx, 54 Cal. App. 3d at 112, 126 Cal. Rptr. at 357 (1975).

ficial effect of creating a large sample of DNA Analysis for statistical evaluation.

CONCLUSION

DNA Analysis will in all likelihood gain acceptance by the courts and become an everyday part of criminal prosecutions in the very near future. This is only the beginning. The influences of science and technology continue to grow in virtually every profession, the law being no exception. As a result, lawyers must be prepared now more than ever before to deal appropriately with the special problems created by the use of scientific evidence. Issues raised go beyond the components of the *Kelly/Frye* analysis for admissibility and beyond the problems of undue time consumption, juror confusion, and the like. The real danger is the temptation to accept without question new forms of scientific evidence which promise to revolutionize criminal or civil trials.

Patience is the key to fair and valuable use of evidence such as DNA Analysis. A cautious approach to its introduction in criminal prosecutions is warranted despite what appear to be inviting opportunities to test the promising capabilities of the new technique. The danger of premature introduction cuts both ways: once deemed admissible, DNA Analysis will be with us to stay, no longer susceptible to any but the most sophisticated challenges to its reliability; once rejected by an appellate court, however, this potentially invaluable forensic tool could become the object of mistrust and remain largely unused.